Jun 19th, 10:50 AM - 11:10 AM

Evidence of a fishway restoring river connectivity in the Neotropical Region

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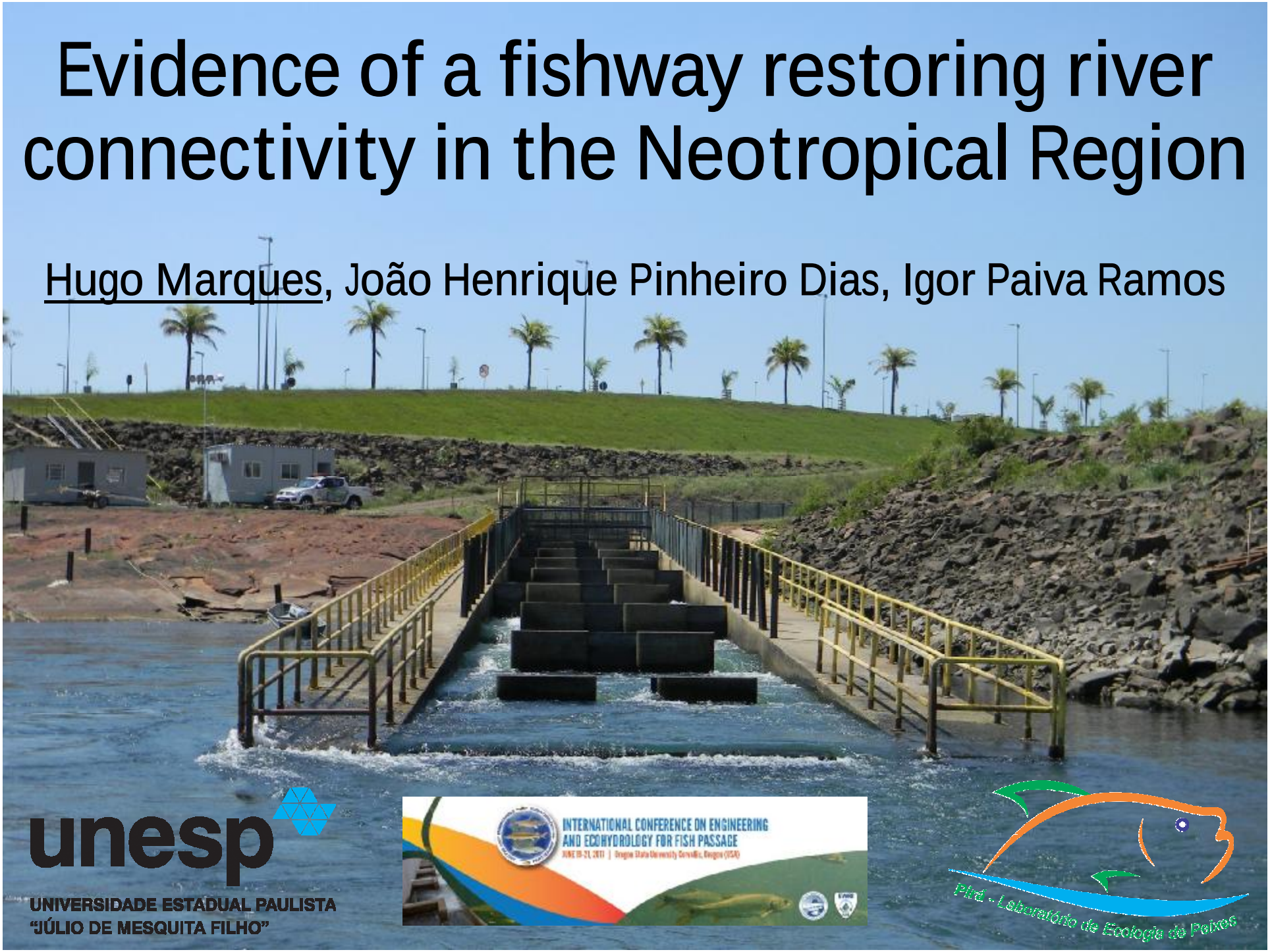


UNIVERSIDADE ESTADUAL PAULISTA
"JÚLIO DE MESQUITA FILHO"

INTERNATIONAL CONFERENCE ON ENGINEERING AND ECOHYDROLOGY FOR FISH PASSAGE

Pird - Laboratório de Ecologia de Peixes

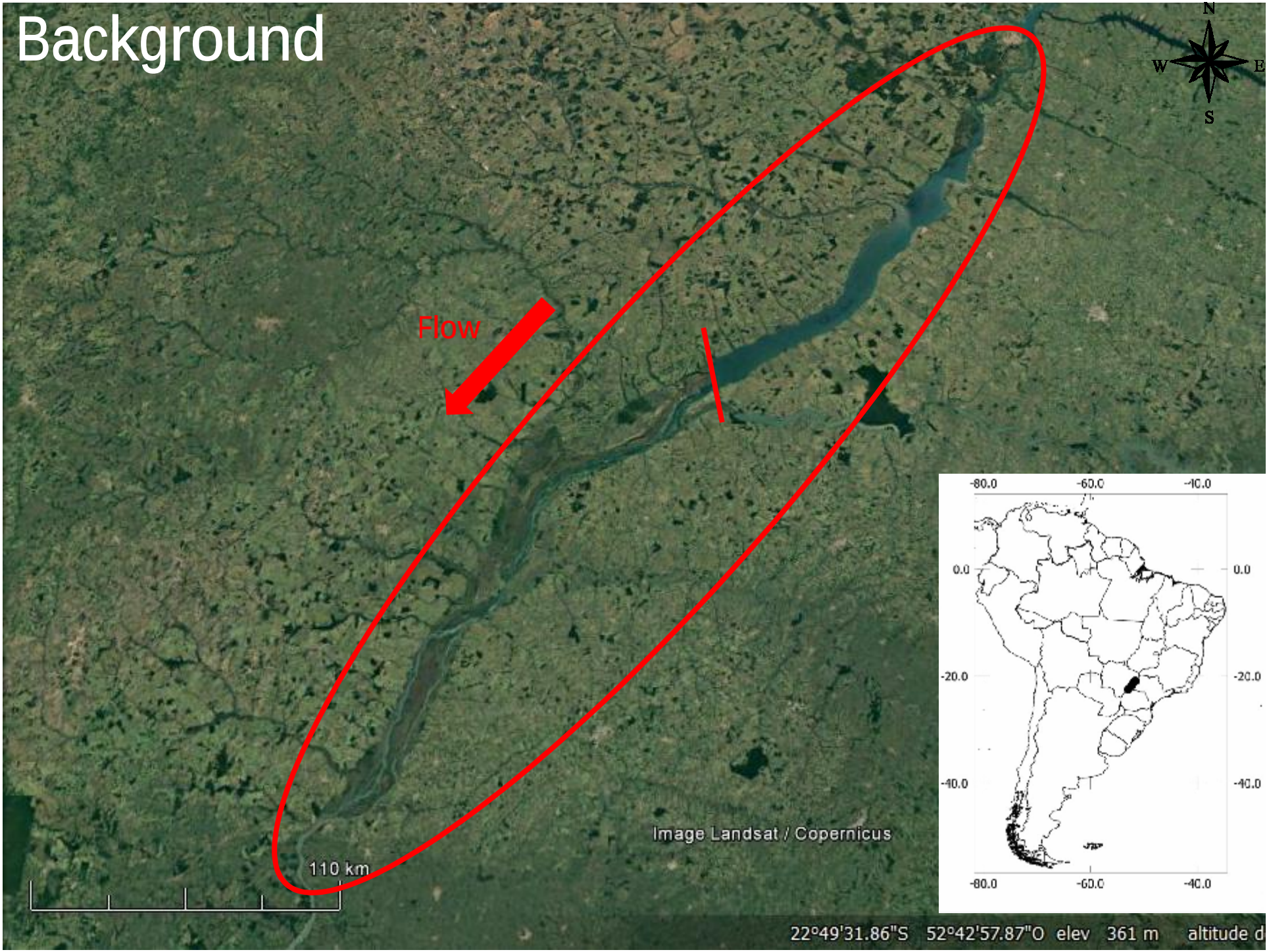
Background

Dams

Habitat Fragmentation

Fish passages

Background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Flow
110 km
Image Landsat / Copernicus
-80.0
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0.0
-20.0
-40.0
22°49'31.86"S 52°42'57.87"O elev 361 m altitude d

Background


Background
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E
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100 km
Image Landsat / Copernicus
21°21'20.39"S 51°54'00.04"O elev 280 m altitude do

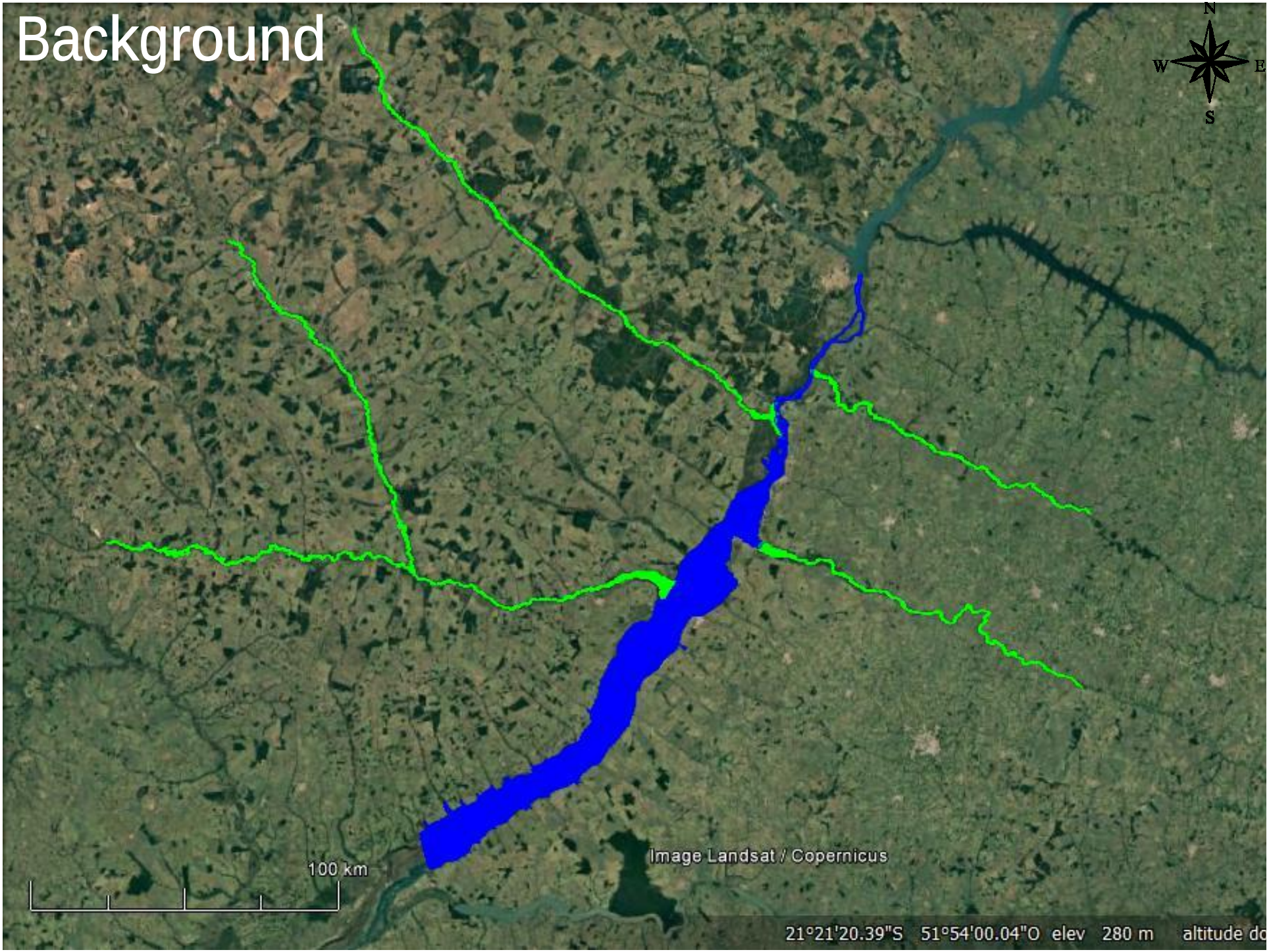
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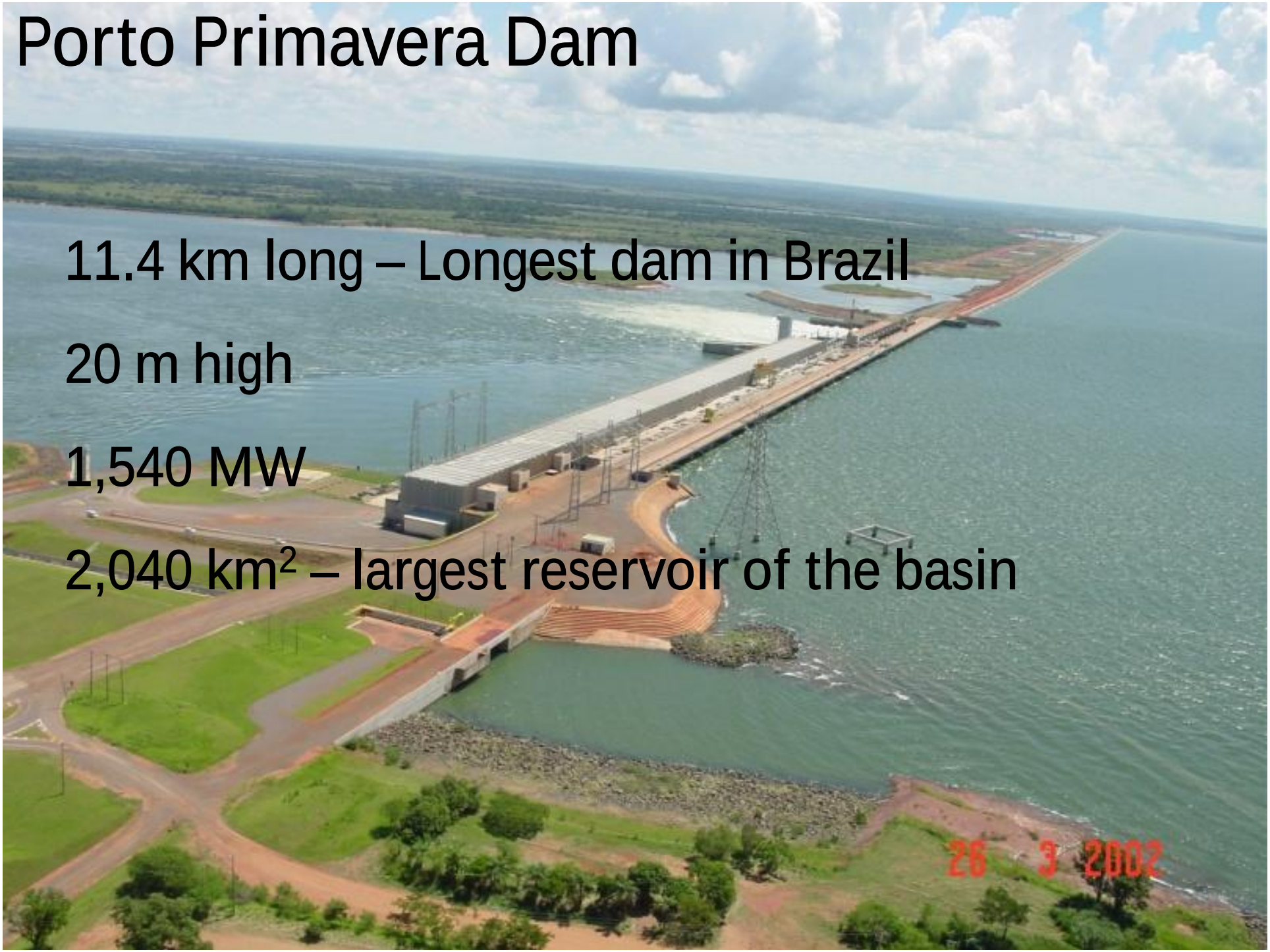
Image Landsat / Copernicus
21°21'20.39"S 51°54'00.04"O elev 280 m altitude do

Porto Primavera Dam



11.4 km long – Longest dam in Brazil

20 m high

1,540 MW

2,040 km^2 – largest reservoir of the basin

A brief chronology

Beginning of construction – 1978

Filling – December 1998

Power plant operation – March 1999

Fishway operation – October 2001 (permanent)

2 years and 7 months without fishway

Fishway

Pool-weir-orifice

520 meters long

5 meters wide

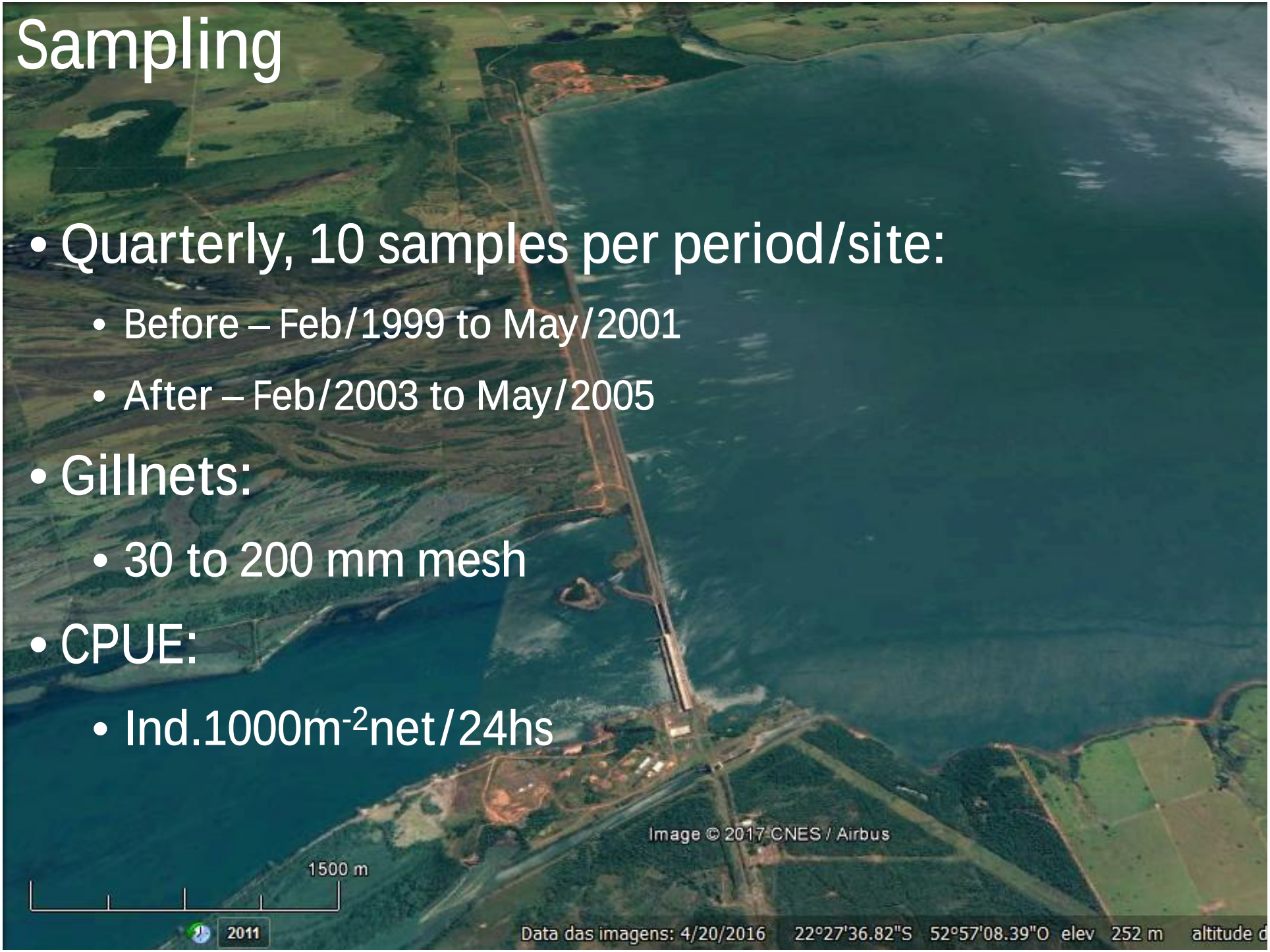
up to 3.5 $m^3.s^{-1}$


Can a fishway restore river connectivity?
CESP
Does the similarity between the downstream and upstream increase after the opening of the fishway?

Sampling sites

Sampling

- Quarterly, 10 samples per period/site:
  - Before – Feb/1999 to May/2001
  - After – Feb/2003 to May/2005
- Gillnets:
  - 30 to 200 mm mesh
- CPUE:
  - Ind.1000m^{-2}net/24hs



Are the fish community upstream and downstream correlated?

2 Mantel tests (Bray-Curtis dissimilarity index):

Upstream X Downstream - BEFORE

Non correlated (r=0.12, p=0.34)

Upstream X Downstream - AFTER

Correlated (r=0.32, p=0.03)

Does the β diversity between upstream and downstream higher after the fishway opening?

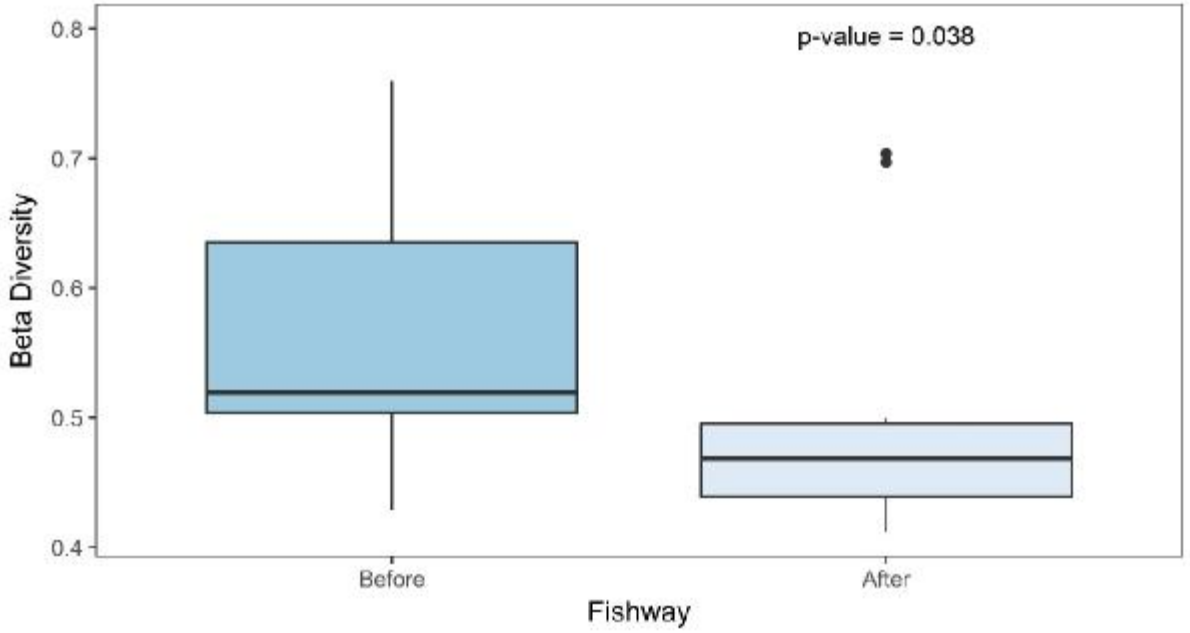
β diversity (Sorensen index) – Upstream X Downstream

Asymptotic Wilcoxon-Mann-Whitney Test – Before X After

Before – median 0.57

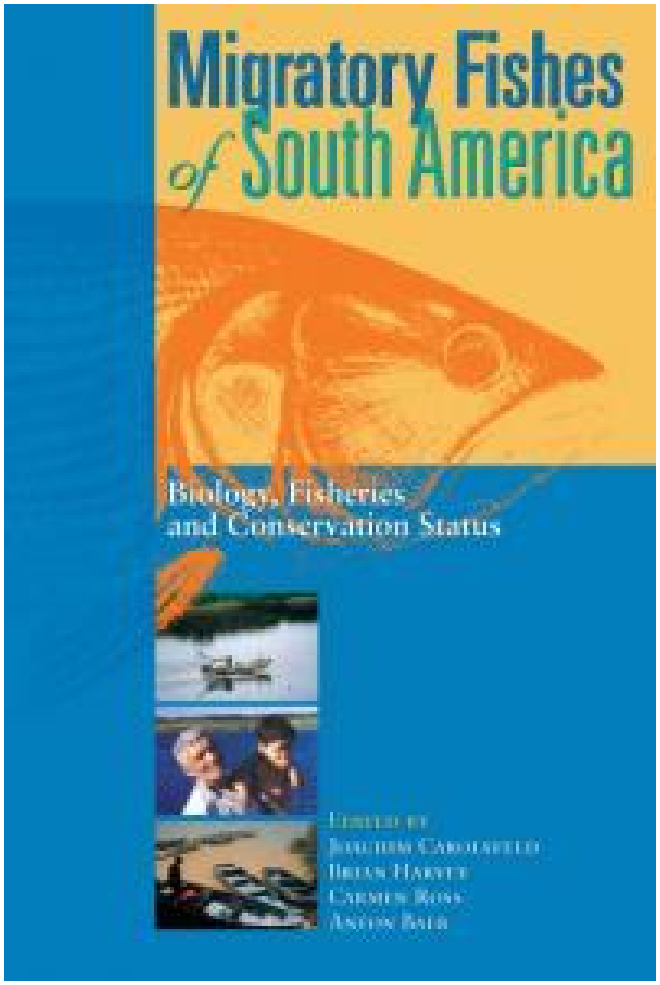
After – median 0.47

Z = -2.08, p = 0.038




Theoretical framework on Neotropical fish passages is still under construction, due...

...high number of migratory species...



…with high diversity of migratory patterns and life histories.

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Published for the Fisheries Society of the British Isles

Journal of Fish Biology (2012) **81**, 866–881
doi:10.1111/j.1095-8649.2012.03346.x, available online at wileyonlinelibrary.com

Diversity in migratory patterns among Neotropical fishes in a highly regulated river basin

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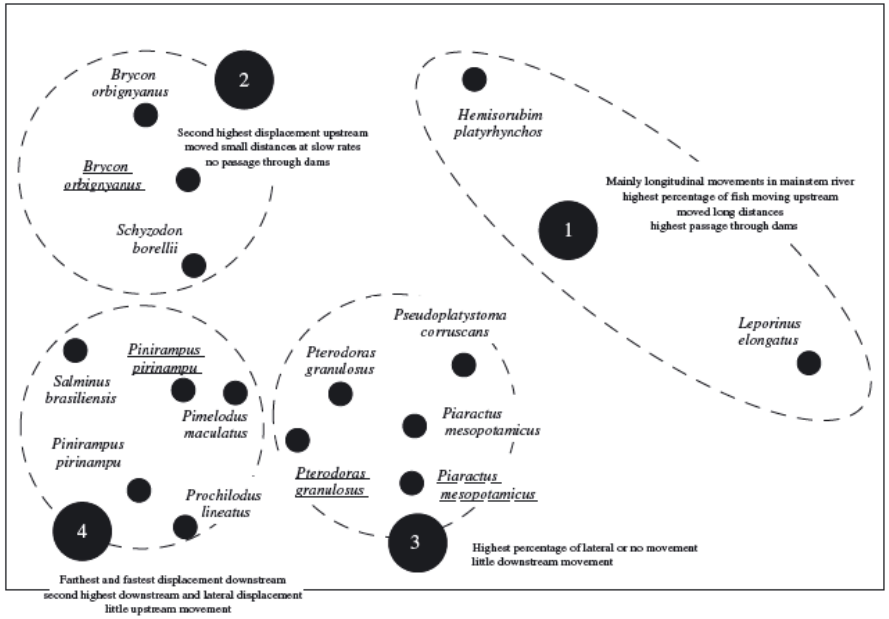

FIG. 3. Non-metric multidimensional scaling ordination of 11 fish species in the impounded Paraná River basin. Underlined species indicate juvenile life stage and circles indicate cluster numbers corresponding to cluster characteristics summarized in Table II.

So the passage performance approach is important...

Neotropical Ichthyology, 10(4):785-795, 2012

Passage performance of long-distance upstream migrants at a large dam on the Paraná River and the compounding effects of entry and ascent

Ricardo Luiz Wagner[1], Sergio Makrakis[2], Theodore Castro-Santos[3], Maristela Cavicchioli Makrakis[2], João Henrique Pinheiro Dias[4] and René Fuster Belmont[4]

This paper presents results of a fishway evaluation performed at the Engenheiro Sérgio Motta Hydroelectric Power Plant (known as Porto Primavera) - CESP, Paraná River, Brazil. The evaluation was designed to quantify entry and passage proportions of 4 long-distance migratory fish species: *Brycon orbignyanus* (piracanjuba), *Piaractus mesopotamicus* (pacu), *Prochilodus lineatus* (curimba), and *Rhinelepis aspera* (cascudo-preto). Proportions finding and entering the fishway differed between species, ranged from 7.4 % (*Prochilodus lineatus*) to 55.4% (*Piaractus mesopotamicus*). Also, proportion passing was different between species, ranged from 31% (*R. aspera*) to 100% (*Prochilodus lineatus*). Fish that were marked and released within the fishway had greater failure rates than those that entered volitionally. Total time to pass ranged from 1.48 hours (*Prochilodus lineatus*) to 178.9 hours (*R. aspera*). Failure rates were greatest in the lower end of the fishway. Although some individuals of all species passed successfully, significant challenges remain to restoring connectivity of the upper Paraná River.

...but not enough.

We must adopt precautional principle...

Contributed Paper

Fish-Passage Facilities as Ecological Traps in Large Neotropical Rivers

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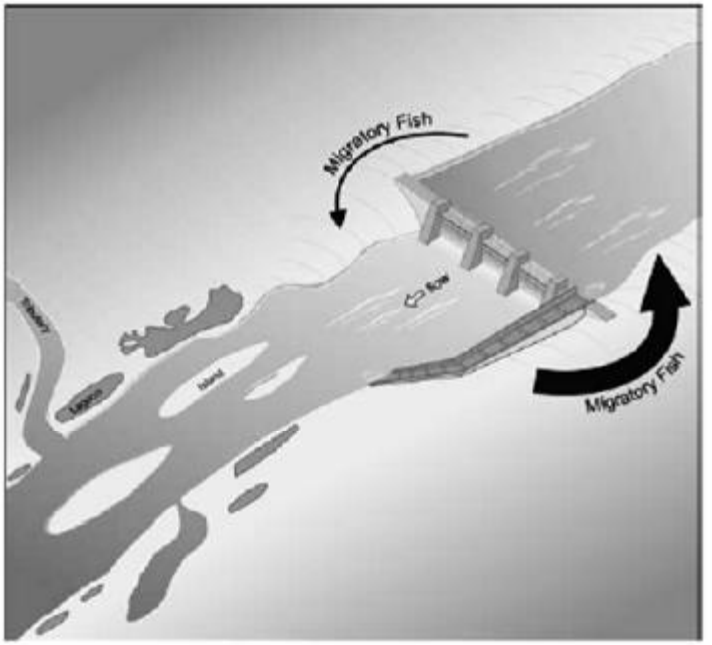

Figure 1. Illustration of how fish passes work as ecological traps in impounded rivers. The region below the dam is characterized by a high diversity of habitats, but the region above lacks critical environments. Fish that pass to the reservoir hardly ever return to areas downriver (arrow size suggests the amount of fish that pass), which ultimately decreases individual fitness.

...and integrate fish passages with life history...

RIVER RESEARCH AND APPLICATIONS

River. Res. Applic. **25**: 702–712 (2009)

Published online 21 August 2008 in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/rra.1180

MIGRATORY FISHES OF BRAZIL: LIFE HISTORY AND FISH PASSAGE NEEDS

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RIVER RESEARCH AND APPLICATIONS

River Res. Applic. (2011)

Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/rra.1557

EXISTING AND FUTURE CHALLENGES: THE CONCEPT OF SUCCESSFUL FISH PASSAGE IN SOUTH AMERICA

P. S. POMPEU,[a*] A. A. AGOSTINHO[b] and F. M. PELICICE[c]

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...and gene flow...

Rev Fish Biol Fisheries
DOI 10.1007/s11160-016-9441-2

RESEARCH PAPER

Genetic structure and diversity of migratory freshwater fish in a fragmented Neotropical river system

Dhiego Gomes Ferreira · Lenice Souza-Shibatta · Oscar Akio Shibatta · Silvia Helena Sofia · Jens Carlsson · João Henrique Pinheiro Dias · Sergio Makrakis · Maristela Cavicchioli Makrakis

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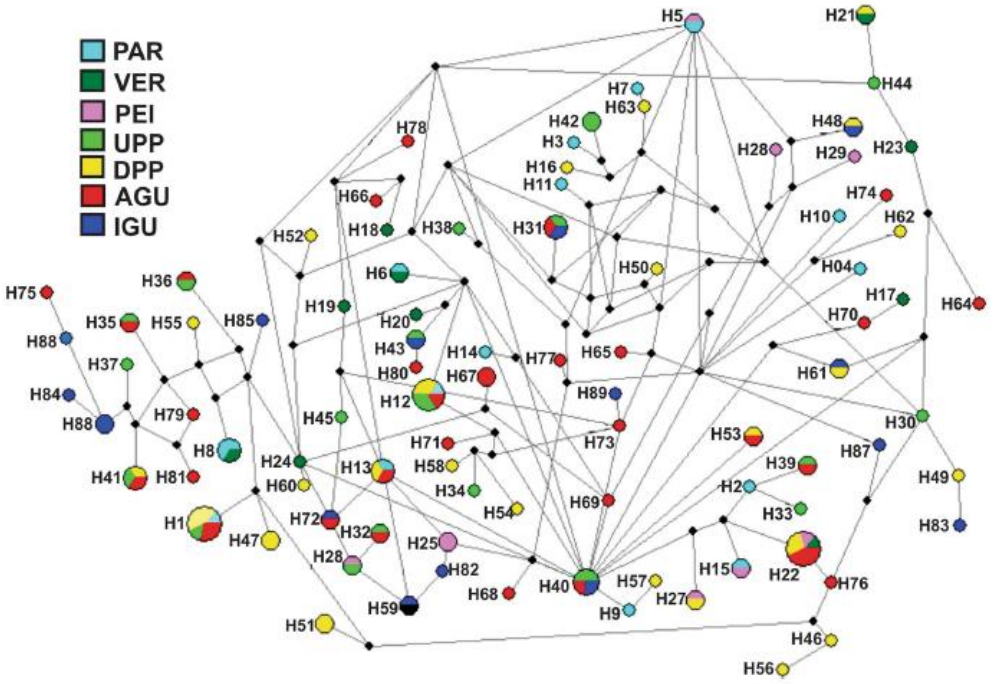

Fig. 2 Haplotype network obtained from the sequencing of the D-loop region (mtDNA) for 139 individuals of *Prochilodus lineatus*. Circle sizes are proportional to the haplotype frequency. Abbreviated sample names are shown in Fig. 1

...in an ecosystemic approach.

American Fisheries Society Symposium 73:559–592, 2010

Migratory Fishes as Material and Process Subsidies in Riverine Ecosystems

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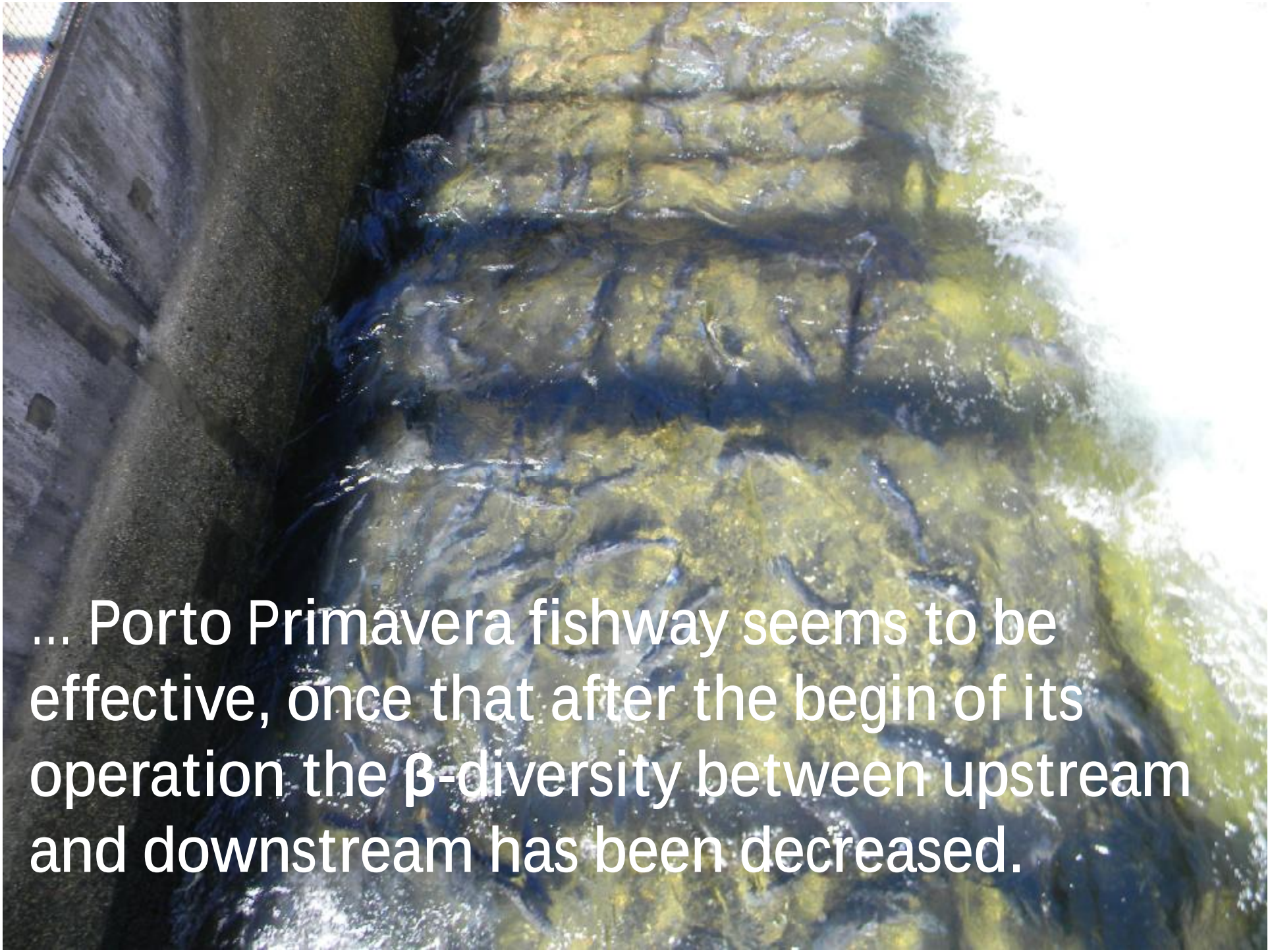
Meanwhile...
Our study indicates that, at least in the point of view of connectivity restoration...


... Porto Primavera fishway seems to be effective, once that after the begin of its operation the β-diversity between upstream and downstream has been decreased.

Acknowledgements


Thanks for your attention!
Questions?
h.marques@outlook.com